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Self-consistent approach to the description of relaxation processes in classical multiparticle systems

Mokshin A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2015, Pleiades Publishing, Ltd. The concept of time correlation functions is a very convenient theoretical tool in describing relaxation processes in multiparticle systems because, on one hand, correlation functions are directly related to experimentally measured quantities (for example, intensities in spectroscopic studies and kinetic coefficients via the Kubo-Green relation) and, on the other hand, the concept is also applicable beyond the equilibrium case. We show that the formalism of memory functions and the method of recurrence relations allow formulating a self-consistent approach for describing relaxation processes in classical multiparticle systems without needing a priori approximations of time correlation functions by model dependences and with the satisfaction of sum rules and other physical conditions guaranteed. We also demonstrate that the approach can be used to treat the simplest relaxation scenarios and to develop microscopic theories of transport phenomena in liquids, the propagation of density fluctuations in equilibrium simple liquids, and structure relaxation in supercooled liquids. This approach generalizes the mode-coupling approximation in the Götze-Leutheusser realization and the Yulmetyev-Shurygin correlation approximations.

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Keywords

disordered system, integro-differential equation, mode-coupling approximation, projection operator, recurrence relation, relaxation process, self-consistent description, spatial-time correlation